NASA model and observation products for the study of land atmosphere coupling and its impact on water and energy cycles

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NASA Energy- and Water-Cycle Sponsored Research

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Project Abstract

NASA/GSFC has a rich heritage of developing offline Land Data Assimilation Systems (LDAS), which serve as testbeds for developing assimilation techniques for NASA observations. However, these systems are uncoupled, and therefore may "overconstrain" the system by simultaneously fixing both atmospheric inputs (or "forcings") and land states, such as snow, surface temperature or soil moisture. Similarly, the long history of local uncoupled experiments conducted by the GEWEX Project for Intercomparison of Land Surface Parameterization Schemes (PILPS) may be missing significant feedbacks due to Land-Atmosphere Coupling. It is as yet unknown what impacts these missing feedbacks have on our ability to estimate parameters and assimilate observations for the purposes of predicting global water and energy cycles.

The NEWS challenge centers around "documenting and enabling improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change." However, progress towards this challenge is currently constrained by our lack of understanding of the factors controlling Land-Atmosphere Coupling (LAC), and the effect of this coupling on efforts to assimilate NASA observations into water and energy cycle prediction systems. The goal of this proposal is to bring NASA modeling and observational assets to bear on the study of this problem, which is central to realizing the NEWS challenge.

We propose to develop a suite of modeling and observational products to study the strength of local LAC, with the goal of providing these products to the developing GLASS LoCo project community and the NEWS science team. The products will support of a number of local studies with global implications, similar in spatial extent to the PILPS experiments, but with a coupled atmospheric boundary layer, and eventually with clouds. The specific NASA model products will include (1) boundary and initial conditions for LoCo sites extracted from the Goddard finite volume general circulation model (fvGCM); (2) the source code for the coupled Land Information System (LIS), Weather Research and Forecasting Model (WRF) and Goddard Cumulus Ensemble (GCE) modeling system, whose development is currently separately funded on a project led by Dr. Peters-Lidard; and (3) data assimilation modules, which have been under development at NASA by Houser, Zhan, Reichle et al. (soil moisture), Rodell et al. (snow), and Bosilovich et al. (skin temperature). The observational products to be provided include land surface parameters derived from MODIS and state variables such as MODIS surface temperature, AMSR-E soil moisture, and MODIS snow cover and/or AMSR snow water equivalent, among others.